

CASE STUDY

Low Solar Heat Gain Windows

Successful Market Transformation in Georgia and Texas



The solar heat gain coefficient (SHGC) is a significant and often the most important feature in energy-efficient windows in southern climates. Dual-glazed windows with a SHGC of 0.40 or less use the latest technology (improved frames and glazing) to reduce the transmission of heat through windows. This can result in cooling energy savings of up to 30 percent or more. These high-performance windows also have lower U-factors that reduce heat loss from inside a home in colder months, contributing to further savings.

Recognizing the significant benefits of high-performance windows, both Texas and Georgia adopted building energy codes that require windows to have a SHGC of 0.40 or less. These states followed slightly different approaches based upon the nuances of their markets to help window manufacturers, dealers, and suppliers, as well as builders and consumers make the transition to low SHGC windows. This case study highlights the reasons behind their decision as well as their successful approaches to market transformation.

Understanding Low SHGC Windows

The SHGC measures the fraction of solar energy striking a window that is transmitted through the entire window assembly including glass, frame, and other window components. A window with a SHGC of 0.40 keeps out 60 percent of the sun's heat—a significant reduction from clear, single-pane, aluminum- or wood-framed windows, which have a SHGC of 0.76 and 0.64 respectively. Because windows account for up to 60 percent of a new home's cooling energy, this reduction has a significant impact.

A low SHGC is generally achieved in homes by applying an invisible, spectrally selective low-emittance (low-E) coating between the panes of dual-glazed windows. This reduces heat gain in summer and heat loss in winter, but it also reduces some beneficial heat gain in winter. A low SHGC can also be achieved by using tinted and reflective glazings. However, low-E glass provides a higher level of visible light transmission (daylight) for a given amount of solar heat reduction, and reduces radiant heat loss through the window in winter.

Benefits of Low SHGC Windows

Low SHGC windows offer a multitude of benefits, including:

- **Cooling energy savings.** In Texas, the Public Utility Commission estimated the annual energy savings at between 2.68 and 9.5 kWh per square foot of window glass per household per year, depending on climate zone and the type of heating and cooling system.¹



- **Reduction in peak load.** The Public Utility Commission of Texas estimated demand reduction at between 0.0024 and 0.0033 kW per square foot of window glass.¹
- **Decreased first cost of air conditioning equipment due to smaller size.** The size of air conditioning equipment often can be reduced because the highest cooling load on the house is lower.
- **Reduced emissions.**
- **Greater occupant comfort in summer and winter.**
- **Decreased fading of furnishings and decreased condensation.**
- **More permanent cooling solution compared to awnings and screens.**

The Texas Approach

In 2001, Texas adopted the Texas Building Energy Standards as an innovative way to help meet federal Clean Air Act requirements in nonattainment areas of the state. The Standards, which went into effect several months later on September 1, 2001, adopted the energy-efficiency chapter of the International Code Council's (ICC) International Residential Code (IRC) as the energy code in Texas for most single-family homes and townhouses. The ICC's International Energy Conservation Code (2000 IECC™) became the energy code for all other residential, commercial, and industrial construction, including single-family homes that have greater than 15 percent glass in the exterior wall area.

- The window requirements in the new code required new and replacement windows to have a SHGC of 0.40 or less in most of the state – considerably better than the SHGC of about 0.73 that was typical practice prior to code adoption.
- Reducing solar gain means reducing air conditioning loads by as much as 30 percent during the summer ozone season.

The Texas Window Initiative

Even before the code was being debated—the Texas Window Initiative (TWI) had begun to lay the groundwork for market transformation to high performance windows. With funding from American Electric Power Company (AEP), TWI trained window manufacturers, distributors, retailers, building product sales professionals, homebuilders, and replacement contractors in the utility's territory on the value

of high-performance windows as well as some of the issues related to making the transition. This training occurred in 2000 and 2001 in AEP's service territory—primarily the less urban areas in central and southwestern Texas.

TWI's market transformation efforts included:

- Conducting 177 trainings to 577 participants at times and places convenient to participants. The two-hour training sessions were free of charge and occurred as early as 6 a.m. and as late as 8 p.m.
- Holding meetings with a number of window manufacturers to ensure that high performance windows were widely available. As a result, several Texas window manufacturers made major changes to their product lines to incorporate high performance technology.
- Emphasizing the benefits of using National Fenestration Rating Council (NFRC) window ratings/labels and the Energy Star® Windows program as ways to identify high performance window products.
- Teaching sales people at window retailers how to identify improved products and how to order and recommend the best products for their customers.
- Addressing concerns about the added cost of efficient windows by presenting several scenarios showing the cost-effectiveness of choosing high performance windows over standard products.
- Highlighting further benefits, such as improved comfort, reduced condensation, and reduced fading.
- Sponsoring three “demonstration home” projects with builders and suppliers.
- Promoting high performance windows in newspaper advertisements, point-of-purchase brochures for retailers and builders, and home and garden show displays.
- Developing an informative Website at <http://www.frontierassoc.com/texwin/>.

Building Energy Code Training

TWI's efforts helped jump start the market's transition to high performance windows in some areas of Texas. Then, after the Texas Building Energy Performance Standards were adopted, the State Energy Conservation Office and Energy Systems Laboratory at Texas A&M offered code training to 3,000 building professionals with funding provided by U.S. Department of Energy (DOE) Special Projects grants. This training addressed

¹ Public Utility Commission of Texas (PUCT). 2002. *Deemed Savings, Installation and Efficiency Standards* [online]. Available from World Wide Web: http://www.puc.state.tx.us/electric/projects/22241/DeemedSavings_final.pdf

all of the code's energy requirements, including high performance windows.

The Georgia Approach

Following the Texas lead, Georgia fully investigated the 0.40 SHGC requirement during its statutorily required review of the 2000 IECC. (State statutes require the Georgia Department of Community Affairs to review and update the state mandatory minimum codes, including the IECC, every six years.) Georgia used the Texas model and market transformation progress as a case study for what they might expect. Several local builders, window suppliers, and manufacturers were involved in the code review and adoption process.

In October 2002, after much debate, Georgia adopted the 2000 IECC as its residential energy code with some substantial state amendments to improve the code. Georgia retained the 0.40 SHGC requirement, but was concerned with the geographical exemption of north Georgia from the 0.40 SHGC requirement. To assist transformation, and upon request from manufacturers that preferred a uniform requirement throughout the state, the final version of the IECC adopted by Georgia mandated the 0.40 SHGC requirement for the whole state (even areas above 3,500 Heating Degree Days).

The code went into effect one year later, on January 1, 2003. However, Georgia delayed until January 1, 2004 all window U-factor and SHGC requirements to allow greater time for the market to transition to high performance windows. The delay was particularly important to small local manufacturers and their suppliers because a significant portion of the market consisted of shop-built windows.

Georgia held general code training workshops for builders and code officials, with funding provided by a DOE Special Projects grant. This training addressed all code changes, including high performance window requirements. In addition, several months before the end of the one-year grace period allowed for windows, the Efficient Windows Collaborative (EWC) held a one-day summit that educated 200 window manufacturers and suppliers on the benefits and issues relating to high performance windows. This workshop, which was funded by the Georgia Environmental Facilities Authority, DOE's Rebuild America program, product manufacturers, Southface Energy Institute, and the Alliance to Save Energy, was successful in:

- Giving builders and suppliers information on how to market windows

- Explaining how to handle the glass or insulated glass units
- Discussing quality assurance, testing, and National Fenestration Rating Council (NFRC) rating, certification, and labeling
- Debunking many of the myths about high performance windows
- Identifying lingering detail-oriented issues that were stalling manufacturers' efforts

By first quarter 2004, manufacturers and suppliers had "caught up," and the code requirement went into effect without so much as a market whimper. As of one year later (January 2005), low SHGC windows had firmly taken hold in the Georgia market.

Issues Relating to Market Conversion

States that have adopted codes requiring low SHGC windows have blazed the trail for those yet to take this step. Their experience demonstrates that yesterday's market barriers are now more perception than reality. Low-E glazing is now used in about 60 percent of residential windows being sold nationwide.³ As the window market has matured, market transformation has proven to be relatively painless as long as the supply chain is given sufficient information and advance notice. With low-E glazing becoming more dominant in the marketplace, the lead time needed for adequate notice is consistently shrinking.

Table 1.0 addresses common questions about window market transformation.

Lessons Learned from the Texas and Georgia Experience

Those involved in the market transformation to high performance windows in these states offer these suggestions:

- **Promised benefits of a mandatory 0.40 SHGC requirement have been realized.** Consumers have been satisfied with better windows. Housing affordability has been improved through neutral first costs (assuming equipment downsizing savings are realized) and lower monthly energy bills.
- **Manufacturers have effectively adapted to provide low SHGC windows.** After an initial capital

² EWC is a market transformation project of the Alliance to Save Energy, www.ase.org.

³ Door and Window Maker Magazine, April 2005:

http://www.usglassmag.com/Door_and_Window_Maker/Backissues/April%202005/Wealth%20of%20Knowledge.htm

Table 1.0 - Window Market Transformation

Question	Resolution/Answer
Do high performance windows cost more?	Although low-E glass previously cost considerably more, high performance windows have become quite competitive particularly as regional markets mature. In a mature market, these windows typically retail for about \$1/sq.ft. of window more than non-low-E windows—a cost consumers are willing to pay for comfort, energy dollar savings, and reduced fading.
Will small local window manufacturers be forced out of business?	This common fear among window manufacturers and suppliers was not a widespread issue in Georgia or Texas. Some companies may have consolidated; others refused to re-tool. But wide scale loss of small shops due to the 0.40 SHGC requirement did not occur.
What new procedures and equipment are required to manufacture these windows?	The construction of window frames may need to be modified. In addition, a company that makes its own insulated glass units will need a new washer, staff training on handling and protecting the low-E coating, and a Quality Assurance program. Testing, certification, and labeling are needed, usually through the National Fenestration Rating Council.
Isn't that a lot of changes to make?	Window manufacturers often are reluctant to make these changes. Afterward, many say that the modifications were not difficult. Regardless of the industry, all products continue to improve with new technology, and manufacturers routinely must make changes to stay competitive amidst consumer demands.

investment to provide low SHGC windows, manufacturers have experienced economies of scale and reduced costs due to streamlined inventories and manufacturing processes.

- **Give manufacturers plenty of upfront information and preparation time.** The most important ingredient for success is to let manufacturers and suppliers know what's coming. Making changes to a product line can take months or longer.
- **Listen to manufacturers' concerns.** Don't merely assume that manufacturers are resisting change just because they resist change. There may be legitimate obstacles that only those in government or industry positions can fix to open the path for transformation.
- **Hold workshops and training. Seek funding from energy organizations, government, utilities, and energy-efficient product manufacturers.**
- **Use advertising when the window code changes go into effect.** Consumers and builders should be informed about what windows should be for sale.
- **Make all window-related code changes at once.** When manufacturers accept a change, they want to know there won't be another one in the near future.
- **Trade-offs should be avoided and any product exemptions from SHGC should be minimal.** To ensure complete transformation, only specific targeted exemptions should be allowed. For example, Georgia allowed a small glazing area exemption for specialty products (glass block, art glass, custom architectural products).
- **Specify a sunset date for pulling permits under the old code.** This protects dealers from having to maintain dual product lines for the old and new codes.
- **Recognize the particular needs of coastal communities.** At this time, few impact and hurricane resistant windows are energy efficient. This market is evolving.

Resources

- Efficient Windows Collaborative: <http://www.efficientwindows.org>
- Texas Window Initiative: <http://www.frontierassoc.com/texwin/>
- Texas State Energy Conservation Office: <http://www.seco.cpa.state.tx.us>
- Georgia Division of Energy Resources: http://www.gefa.org/energy_program.html



Building Energy Codes
U.S. Department of Energy

CONTACT INFORMATION

Building Energy Codes Website:
www.energycodes.gov

Tech Support:
www.energycodes.gov/support/helpdesk.php

REScheck™ and **COMcheck-EZ™**
can be freely downloaded directly from
the Energy Codes website.

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prosperous future
where energy is clean,
abundant, reliable,
and affordable**